

THE SIMILARITY OF THE SHORT-PERIOD BAROMETRIC PRESSURE VARIATIONS OVER LARGE AREAS.

IN an earlier number of this Journal (vol. lxi. p. 248, July 10, 1902), an account was given of the great similarity of curves representing many solar and meteorological

months in which the pressures are above and those in which they are below the normal, the normal being the mean pressure for the whole period under investigation in each locality.

Thus, for instance, to take the cases of Bombay and Cordoba, the former has its high-pressure months from April to September and the latter from September to March.

It happens, therefore, in dealing with large areas, that during the same period of time (that is generally, but not invariably, six months) the pressure is above the normal in some places and below the normal in others. In interpreting the curves, therefore, it should be borne in mind that in the one case in which high-pressure months are considered, the crests of the curves denote times of increased pressure, or an excess above the normal conditions, while in the other, where the low-pressure months only are employed, the crests represent the times at which the pressure is not so low as usual.

Dealing first with the region about India, the accompanying curves (Fig. 2) illustrate the variations of pressure which have been analysed. In this set of curves, about the same months are in question, so that the pressure

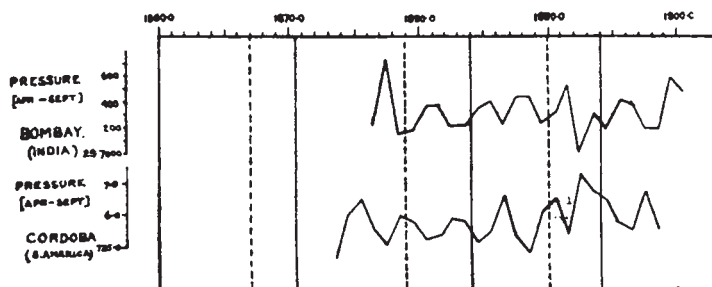


FIG. 1.—In this and all the subsequent figures, the continuous and broken vertical lines represent the epochs of sunspot maxima and minima respectively.

logical phenomena,¹ and it was suggested that their close accordance indicated, not only the intimate relation between solar and meteorological changes, but the importance of the short-period (three to four years) variations common to them all. The variations of solar activity, as indicated by the greater or less number of spots or prominences or by the changes of latitude of the former, were suggested to have such an action on the atmospheric pressure on the earth's surface that when one place recorded an excess, another, nearly antipodal as regards position, showed a deficiency of pressure. Thus the regions specially referred to were those of India and that about Cordoba, in South America.

This reversal of conditions, extreme high pressure in one place and low pressure in another at the same moment of time, independent of the yearly or seasonal change, a fact which has since been corroborated by another investigator, as will be seen further on, can be well seen by examining two pressure curves such as those of Bombay and Cordoba (Fig. 1); in each case, the mean pressure for the same months has been used.

In the paper already referred to, it was further pointed out that just as the pressure variations of Bombay were typical of the whole of India, so were those of Oxford (England) or Valencia (Ireland) for western Europe.

With these facts in view, it was important, therefore, to investigate the extent of regions having similar pressure variations, and in the first instance to restrict the inquiry to those areas surrounding India and Cordoba. The results of such a barometric survey were communicated to the Royal Society last October,² and it is the purpose of the present article to state the results which have been obtained.

It may, however, first be mentioned that the monthly means of the pressure variations for each station were divided, as in the previous article, into two periods, namely, those

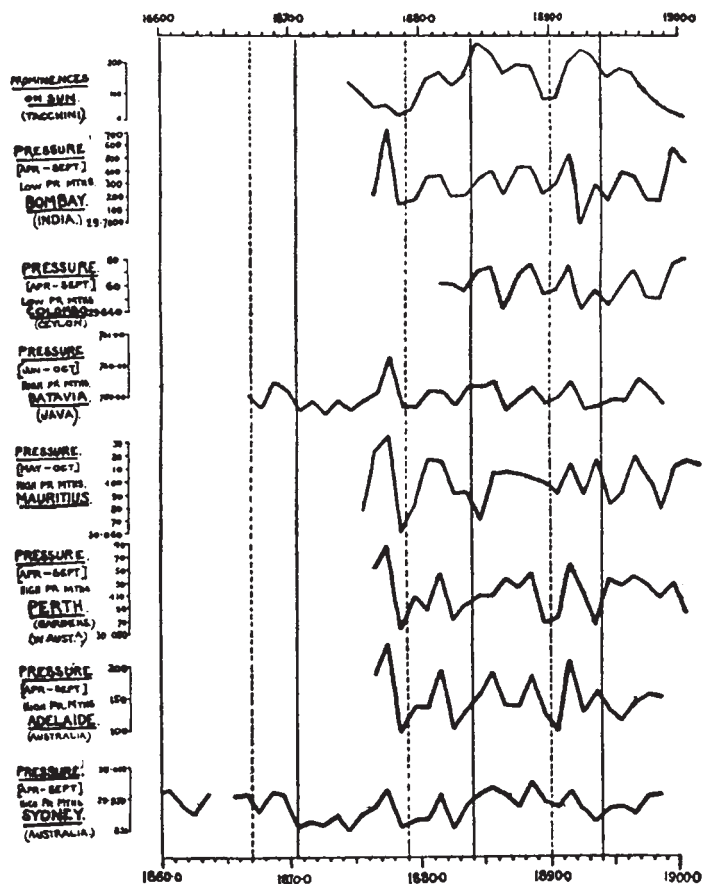


FIG. 2.

variations refer to the low-pressure (summer) months in the northern hemisphere and to the high-pressure (winter) months in the southern hemisphere.

Commencing with Indian pressures (as represented by Bombay), the area was gradually extended to Ceylon

¹ "On Some Phenomena which Suggest a Short Period of Solar and Meteorological Changes," by Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S. (Roy. Soc. Proc., vol. lxx. p. 500). [Received June 14, read June 10, 1902.]

² "On the Similarity of the Short-Period Pressure Variation over Large Areas," by Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S. (Roy. Soc. Proc., vol. lxxi.). [Received October 18, read December 4, 1902.]

(Colombo), Java (Batavia), Mauritius, and finally to Australia (Perth, Adelaide and Sydney).

The striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variations is in action, and that therefore the whole region is intimately connected meteorologically.

Attention was next paid to extending the region around Cordoba, which station, as has been previously pointed out, exhibits pressure variations similar to, but the inverse of, those of India.

As Cordoba represents an area south of the equator, and the neighbouring stations exhibit similar pressure variations, a portion of the United States of America was taken as typifying an area with north latitude and in about the same longitude, and a commencement was made along the lowest available parallel of latitude.

This was rendered possible by the kindness of Prof. Bigelow, who forwarded proof sheets of a new reduction of United States pressures which he had just completed.

Treating these pressures in the same way as those for the Indian region, several stations which had the best record were chosen. A graphical representation of the variations of four of these stations (Mobile, Alabama; Jacksonville and Pensacola, Florida; San Diego, California) is given in Fig. 3, and for the sake of comparison the pressure of Cordoba, with the *inverted* curves representing the Bombay pressure and solar prominence variation. This series of curves refers in all cases to the variations of the means of the high-pressure (winter) months (October to March in most cases). At Cordoba, which has a southern latitude, the high-pressure months extend from April to September.

The result of the comparison shows that in this region of the world we have also a large area the pressure variations over which are very similar to one another.

Although the general agreement between the two main sets of curves is most striking, there are minor differences which probably will eventually help to determine those cases in which the prominence effects on pressure are masked by some special conditions.

From these collected series of facts it will be seen that, as regards similar short-period pressure variations, the two regions about India and Cordoba have been considerably extended, and extended on both sides of the equator in each case.

With these two large areas indicating similar barometric variations from year to year, but one showing an excess while the other displayed a deficiency, new questions were at once raised. It required, however, a far more general barometric survey over other areas before such questions could be answered, but so suggestive were the facts observed that, as was stated in the paper, such an inquiry was at once undertaken and is still in progress.

It may, however, here be mentioned that already many other localities have been examined. The Indian area has been extended, for instance, to Aden and Egypt, the former of which places is practically a counterpart of India as regards these barometric variations, while the latter approximates to it. If, on the one hand, we denote land areas the barometric variations of which are very like those of India with a positive sign, and those with a positive query sign (+?) which are more like India than Cordoba; and, on the other, pressures

similar to those of Cordoba with a negative sign, and those which are more like Cordoba than India with a negative query sign (-?), then it is found that, so far as barometric observations which have as yet been examined are concerned, the earth's surface may be divided approximately into two main regions, one positive the other negative, separated from one another by areas the pressure variations of which may, according to the above notation, be described as positive and negative queries (+?, -?).

It is fortunate that while this reduction and collation of barometric facts has been pursued in this country, another investigator has been working on similar lines in the United States, making it possible to compare results. In fact, Prof. Bigelow's research,¹ which was received some time after the above-mentioned was communicated to the Royal Society, has led him to very nearly

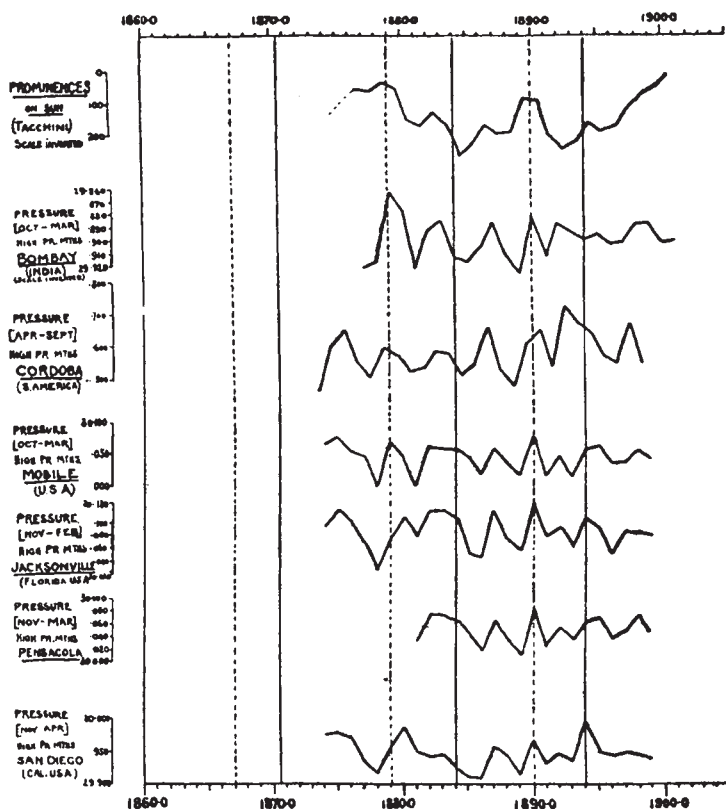


FIG. 3.

the same conclusions as those stated in the present article, if some minor differences be excluded. One of these differences arises from the fact that he has formed the mean of barometric observations made over an area including north-east China, Japan, north India, central India, south India, Batavia and Mauritius, while there seems evidence to show that the whole of India, Batavia and Mauritius behave differently from Siberia, northern China and Japan. This, however, he somewhat concedes later in his article as he points out that "in Siberia and Russia the synchronism begins to break a little . . ." Another difference will be referred to a little further on.

Apart, however, from these, Prof. Bigelow finds that "the same pressure variations, in fact, prevail over very

¹ *Monthly Weather Review*, vol. xxx. No. 7, p. 347, "Studies on the Statics and Kinematics of the Atmosphere in the United States, No. vii., A Contribution to Cosmical Meteorology" by Prof. Frank H. Bigelow (dated August 12, 1902).

large districts of the earth though varying from one region to another."

He says further:—

"If we compare the successive pressure groups with the prominence curve, it will be seen that India and south-eastern Asia are in very close synchronous agreement. This synchronism extends also to New South Wales, the Indian Ocean and even to South Africa. In Siberia and Russia, the synchronism begins to break a little and seems to be transferred somewhat towards the right, although this may be due in part to defective data. In Europe and in the United States, while the same curve is developed as to the number of the maxima and minima, the synchronism becomes more irregular. In South America, on the other hand, the synchronism is resumed very distinctly, but the *entire curve is reversed as referred to India and the Eastern Hemisphere*. Thus we perceive that around the Indian Ocean the synchronism is clearly developed; it weakens in Europe and North America, and it becomes a distinct reversal in South America . . ."

From the above, it will be seen that Prof. Bigelow also demonstrates the existence of large areas which are in excess and in defect of pressure simultaneously, while others are not in such close synchronism.

It may here be mentioned that he treats North America as a whole and gives a curve showing the short period variation of pressure. It is of interest, however, to note, as has been shown earlier in this article, that the southern

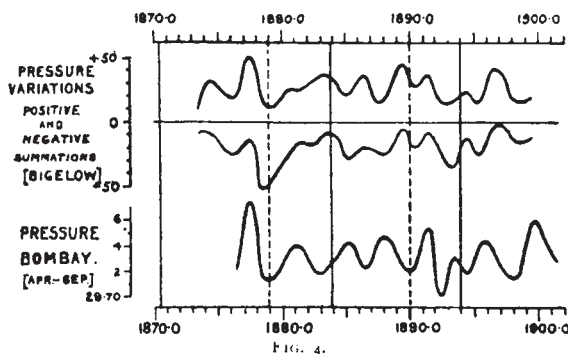


FIG. 4.

part of the United States, as represented by stations shown in Fig. 3, is in very close agreement with Cordoba, while it is the more northern parts and Canada where the synchronism more apparently begins to break.

At the conclusion of his paper, Prof. Bigelow makes a summation of all those areas which give positive and negative values respectively for the pressure variations, and the curves of these are reproduced here (Fig. 4) with a slight change to make the scale homogeneous with others reproduced in this article. The Bombay pressure curve has also been added, and a smooth curve is drawn through the points instead of connecting them with straight lines as in Fig. 2.

The parallelism of the two upper curves indicates, as Prof. Bigelow points out, that "the values do not cancel each other," and that as "the curves match fairly well with the prominence curve, . . . I take it to mean that *some external force is at work to raise and lower the total atmospheric pressure by a small amount from year to year.*"

The two investigations are in agreement as regards the following three main points. First, the close connection between solar activity and barometric pressure; second, the great extent of areas over which very similar pressure variations exist; and, third and last, the presence of two large areas the pressure variations over which are the reciprocal of each other.

It is interesting to remark that, from the comparisons of the pressure variations over the different areas, the authors of both these investigations were led to consider whether these suggestive features were connected with the idea of a periodical see-saw of pressure extending over a few years between these two nearly antipodal areas, or whether we were in presence of a barometric wave travelling round the earth.

There seems little doubt that when more facts are collected these reciprocal pressure variations will in time play an important part in forecasting the general features of seasons and thus supply meteorologists with another means of helping them in their difficult task.

The value that must in future be placed on observations of the sun which inform us of his state of activity or quiescence, since these pressure variations are apparently so closely connected with them, cannot any longer be laid on one side, but must be recognised as of a high order of importance.

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EDUCATION IN GERMANY AND ENGLAND.

MANY people in this country, eminent men of science and literature, leading men in commerce and industry, and politicians who place efficiency before party shibboleths, have for many years felt apprehensive as to the condition of our national system of education. For a long time, they have been speaking and writing upon the subject and endeavouring—by pointing to advancements and achievements of other nations who have put their educational house in order—to stir up the nation at large to realise the enormous interests which are at stake. For many years, the warnings fell upon deaf ears and the advocates of reform were either looked upon as bores or cranks. To-day all this is changed, and it is almost unfashionable not at least to talk about education; this does not, however, necessarily imply a knowledge of the subject.

Were it not for its terrible prolixity, those who really desire to know the ins and outs of the German educational system could not do better than carefully study vol. ix. of "Special Reports on Educational Subjects," dealing with Germany, which is issued by the Board of Education. A mere glance at this report shows that, although the present system of education in Germany has been of such incalculable value to the Empire, yet those interested in education in that country—and their name is legion—are questioning whether their system is after all so good as it might be. There are many in Germany who think that some of our freedom from restraint would give a breadth of idea and a broadness of horizon which is not obtained by their methods of abstract reasoning and rigid exactness.

The report embraces primary, secondary and technical education. The first 200 pages consist of dissertations by different writers upon different aspects or phases of education. The first of these is by Mr. M. E. Sadler, who has compiled the report, upon "The Unrest in Secondary Education in Germany and Elsewhere." This also includes a comparison between English and German methods. Mr. Sadler admits at once that we have an insufficiency of good secondary day schools and that education at our public schools is not what it should be. Further, our technical training is defective, and, owing to our comparative neglect of national education for many years past, "as a nation we are much less intelligently interested than the Germans in methods of instruction." It is true that German and French methods are now very much advocated in this country, but the great difficulty is that those who desire us indiscriminately to imitate and introduce curricula and methods from other nations seem totally unable to realise that if we wish for an exact copy, we must at the same time reproduce the social and economic conditions of these other countries.